RIPARIAN BIRD MONITORING IN MONTANA

ANNUAL REPORT

Report for Year 3 of Personal Services Contract (FWP Contract # 030173) executed 14 May 2004 by and between the Montana Department of Fish, Wildlife, and Parks, and The University of Montana

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Executive Summary

This report covers the activities and results produced under FWP Contract # 030173 in 2005, the final year of the 3-year agreement with Montana Fish, Wildlife and Parks.

The Montana Coordinated All-Bird Monitoring (CBM) Program is a collaborative effort by managers and bird specialists to prioritize monitoring needs and integrate bird monitoring efforts for the purpose of identifying declining species and causes of declines. Understanding the statewide status of species will provide critical information for making management and conservation decisions in Montana. Implementing long-term monitoring of birds in riparian habitats is considered a top priority by CBM partners because these areas support a high number of bird species in the state, are threatened by a variety of human impacts, and are poorly sampled by existing bird survey programs.

Overview of 2005 accomplishments under FWP contract

- Finalized riparian monitoring plan and protocols for the Montana Coordinated All-Bird Monitoring Plan.
- Established long-term monitoring sites and conducted point count bird surveys in 5 watersheds in western Montana.
- Collected associated habitat data for developing habitat models.

Background

Riparian habitats are known to support the highest diversity of breeding birds of any habitats in the western U.S. They also serve as critically important migration corridors for a wide variety of bird species, from waterfowl to canopy-dwelling warblers. At least 134 (55%) of Montana's 245 species of breeding birds use riparian areas during all or part of the year, including 54 (50%) of the 107 Montana Partner's in Flight (PIF) priority species. Because riparian areas are highly productive and often occur at lower elevations and in valley bottoms, they are also among the most impacted by human activities, including conversion to agriculture and development, alteration of waterways for irrigation and power, and grazing (Johnson 1992, Rood and Mahony 1995, Scott et al. 1997, Miller et al. 2003, Scott et al. 2003, Sweeney et al. 2004).

Despite the importance of riparian areas to maintaining bird diversity and the rapid loss and degredation of these areas by anthropogenic factors, there is little information on the habitat requirements and population trends of riparian bird species in Montana. Therefore, collecting baseline and long-term trend data and understanding habitat requirements for riparian bird species are considered a priorities in Montana's CBM plan. Furthermore, a standardized monitoring plan targeted at riparian areas, including site selection, bird survey protocols, and habitat sampling, is neccessary to integrate various montioring efforts by multiple CBM partners across the state. Starting in 2002, the Avian Science Center, with funding from PPL-Montana and the Bureau of Land Management (BLM), conducted intensive bird surveys along > 500 mi Madison/Missouri River Complex. Sampling protocols were developed and tested, and bird data were used to develop habitat relationship models. These models identify critical areas of habitat along these rivers and predict changes in focal species populations with changes in habitat availability and structure (Fletcher et al. 2005). To expand this program statewide, in 2004 Montana Fish, Wildlife, and Parks funded the Avian Science Center to determine the accessibility of riparian habitats along major rivers (4th order or larger streams) in Montana, ground-truth potential sites, and conduct a pilot season to adjust the Madison-Missouri PPL-MT study sampling protocols to effectively survey larger river systems throughout Montana.

The objectives for the 2005 contract year were to provide riparian bird data for the Montana CBM plan and collect information on habitat associations. To meet these objectives, we finalized a riparian monitoring plan for the CBM based on the findings from the 2004 pilot season. Following the protocols in this plan, we set up long-term monitoring sites, conducted bird surveys, and sampled vegetation on riparian habitats along large-order streams in western Montana.

Final Riparian Monitoring Plan

Sampling Design

Many of the factors influencing riparian birds occur at large scales (e.g. habitat availability and configuration, landscape context. In order to analyze the influence of these factors, we developed a watershed-based sampling design where watersheds (4th code HUCs) are randomly selected for monitoring from all watersheds in the state containing a large-order stream (Fig. 1). Analysis of the Madison–Missouri PPL-MT dataset revealed distinct vegetation and avian communities at this large geographic scale, and more importantly indicated that avian-habitat relationships can differ by geographic region according to limiting factors specific to that region (Fletcher et al 2005).

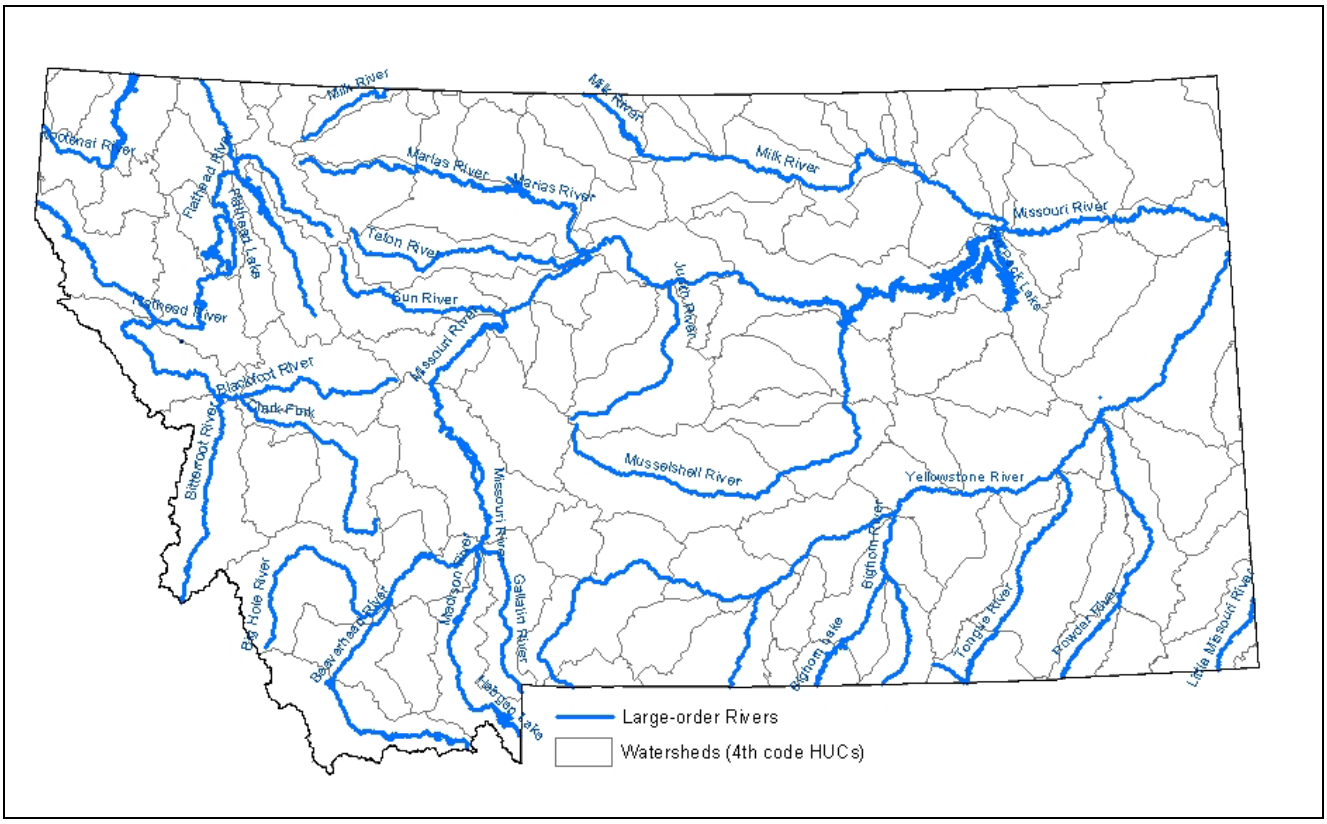

Figure 1. Map of Montana's watersheds and major rivers.

Selection is limited to watersheds that contain sufficient accessible riparian habitat. In a single survey year, watersheds will be surveyed in either western or eastern Montana to reduce logistical costs. Therefore, selected watersheds will be surveyed bi-annually. In the future we can adjust these methods to target MTFWP aquatic priority watersheds if they are not sufficiently being sampled using this purely random design.

Riparian habitats along large-order streams tend to occur discontinuously in linear bands of highly variable size and are primarily located on private lands. The Landbird Monitoring Program (LBMP) sampling design in which point count stations are located systematically along a 1 km transect (Hutto and Young 2002) was not considered a suitable approach for targeting riparian areas, because a majority of points would fall outside of riparian areas and would require access from numerous landowners per transect. Therefore, we developed a sampling design specifically for monitoring riparian habitats where riparian patches within each watershed are randomly selected, given the constraints that patches must be at least 50 m wide, separated by > 400 m, accessible and with necessary permissions granted. Sites must be accessible either by land, or within a reasonable floating distance from the nearest public river access and located on a river section with < class III water. Permanent point count stations are established within each patch using a grid-based approach. Within each selected riparian patch, we then overlay a 150m x 150 m grid parallel to the main axis of the riparian patch, and locate point count stations in the center of each grid cell (Fletcher et al. 2005). This approach maximizes survey effort within each patch regardless of patch shape. Approximately 10-15 patches in a watershed can be surveyed by a two-person field crew in one week, making this an ideal target for balancing survey effort with logistical constraints and travel costs. For more intensive studies of a single watershed, additional patches can readily be selected.

All technicians hired will be experienced in riparian bird identification, be competent class II boaters, and have solid outdoor experience. Prior to the field surveys, all technicians will be intensively trained in local bird identification with emphasis on songs and calls. Additionally, a river safety course will be completed.

Bird Surveys

Each point will be surveyed two times during the breeding season, following standard point count protocols (Hutto et al. 1986), with some modifications to allow for estimation of detection. At each point, all birds detected by sight or sound within a 50-m radius of the point during a 10 minute interval will be recorded. Surveys will be conducted within the 5 hours following sunrise, on mornings without high winds (≥ 20km/hr) or precipitation. For each individual bird, observers will record how they were detected (song, visual, or call), sex, distance from the center point, and in which of four 2.5 minute intervals the bird was detected. Distances (m) to birds are estimated using a rangefinder.

The inclusion in the protocol of two visits to each survey site and efforts to account for variation in detection probabilities are based on results from ASC surveys conducted in riparian habitats along the Madison and Missouri Rivers in 2004. During these surveys, one sampling visit only picked up approximately 70% of the species detected across both visits (Fig. 2) and was therefore inadequate for accurately estimating species richness and detecting less common species. In addition, analysis of detection profiles developed using distance estimates taken during surveys showed declines for many species even within 50 m. Distance sampling approaches and removal models are two approaches that only require some ancillary data that can easily be recorded with conventional point counts (e.g. distance to detected birds and time interval of detection) (Buckland et al. 2001, Farnsworth et al. 2002).

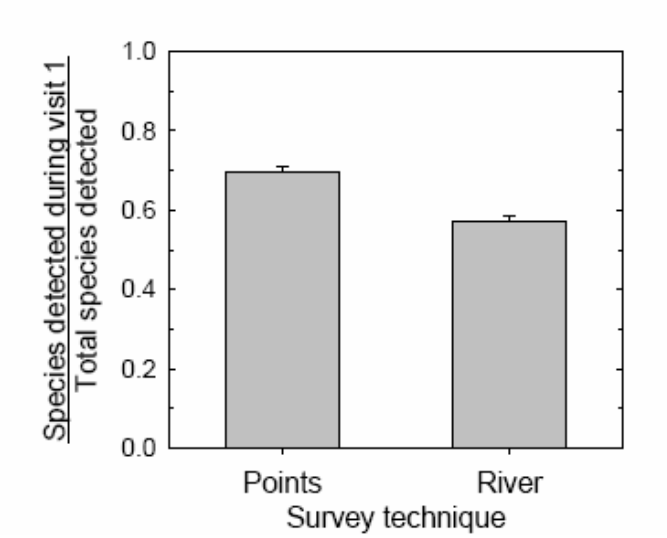

Figure 2. The percent of species detected during the first visit, (relative to total detected during 2 visits) for point count and river transect surveys along the Missouri and Madison rivers in 2004.

Vegetation and Habitat Sampling

Vegetation structure and composition will be sampled once at each point-count station. Vegetation will be measured within plots at 4 sample locations positioned at the center of the point, and 25 m from the center at 0°, 120°, and 240° bearings (Fig. 3). Within 5 m of each sample location shrub cover (by species), cottonwood sapling cover (by species), and ground cover are sampled based on overlapping ocular estimates. Ground cover categories include woody, grass, forb, woody debris, litter, bare ground, and water. The number of cow pies within each 5 m plot are counted as an index for grazing intensity (Beever et al. 2003). Within 11.3 m of each sample location, the total number of trees by species and size class (10-20 cm, 20-40, and >40 cm) are counted. Tree canopy height (using a clinometer) and average shrub height (shrubs > 1 m) at each location are also measured. Canopy cover is estimated by averaging 4 densiometer readings (one in each cardinal direction).

This protocol is designed to capture vegetation structure and composition associated with monitoring sites. Additional vegetation measures of interest may also be added to meet the objectives of individual studies.

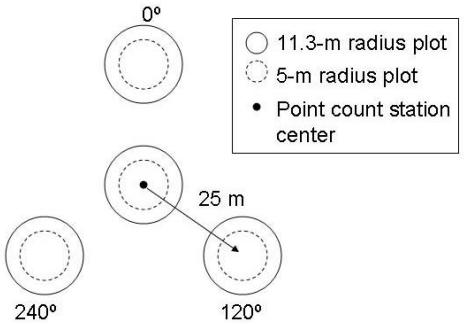

Figure 3. Diagram of vegetation sampling design.

2005 Riparian Monitoring

During the spring of 2005, we began the hiring, planning, and site selection. We chose 5 randomly selected watersheds in western Montana, including two watersheds considered a high aquatic priority (rank=1) in the MTFWP Comprehensive Wildlife Plan (the Bitterroot and Big Hole). The North Fork Flathead watershed was originally selected, but later replaced with the Lower Flathead watershed because most of the riparian habitat was not safely accessible this spring due to high water runoff. At least 10 riparian patches were selected within each watershed, and 1 to 8 point count stations were established within each patch (Fig. 3). In all, 56 riparian patches containing 172 points were surveyed two times each during the breeding season. The majority of patches were located on private land (56%), 16% were on State land, 14% were on tribal lands, 9% on federal, and 5% were on land owned by local government municipalities (Appendix A).

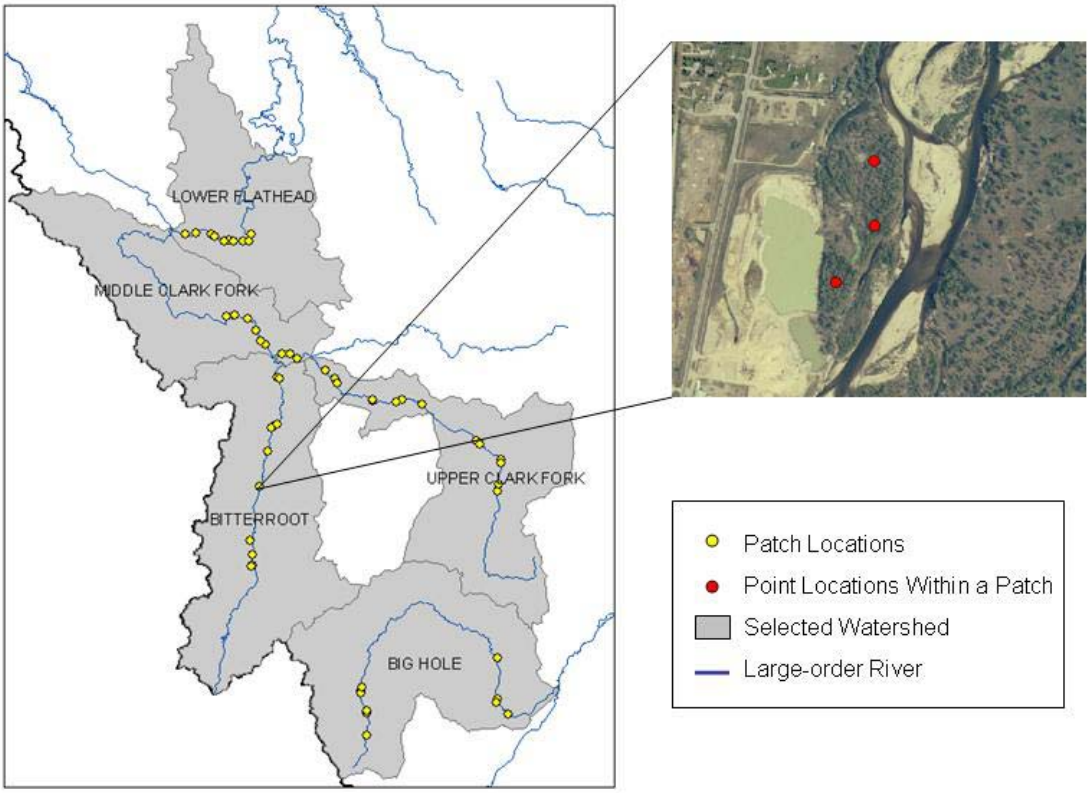

Figure 3. Watersheds selected in western Montana in 2005 for long-term monitoring (n= 5 waterhseds, 56 patches, and ? points). The aerial photo shows an example of a selected riparian patch in the Bitterroot watershed, near Hamilton, Montana.

We hired, trained, and supervised two technicians to set up and conduct riparian bird surveys following the final riparian monitoring protocols (see above section). These technicians created maps and contacted all land owners to obtain necessary permission prior to surveying. Anna Noson also conducted a full-season of field work and enlisted the assistance of additional ASC staff and volunteers. We partnered with Montana River Guides to provide a river safety course for all involved in river-based surveying.

Bird Surveys

During riparian surveys in western Montana in 2005 we detected 99 bird species and 1556 individuals including a number of MT Partner In Flight (PIF) priority species (Appendix B). Yellow Warblers were the most abundant species across all watersheds combined; they are more than twice as abundant as the next most common species. The next four most commons species include the Brown-headed Cowbird, American Robin, Western Wood-pewee, and Song Sparrow. However, species abundances varied by watershed. For example Willow Flycatchers were far more common at points in the Upper Clark Fork, and Wilson's Snipes were primarily detected in the Big Hole. All bird survey data will be available for download at: http://avianscience.dbs.umt.edu/research_riparian.htm.

Habitat/Land Use Results

The types and proportion of riparian habitats also varied across watersheds (Table 1). Most points were located in cottonwood bottomland; however, over half of points on the Big Hole were in willow, and both the Lower Flathead and Upper Clark Fork contained a number of points in other woody streamside riparian habitats. Only 18% of all points had evidence of livestock grazing. However, the percentage of points with signs of grazing also varied greatly by watershed. Over 60% of points in the Big Hole were grazed, while none in the Bitterroot showed signs of grazing (Table 2).

Table 1. Percentage of points located in each major riparian habitat sampled in 2005.

Habitat Type	Big Hole	Bitterroot	Lower Flathead	Middle Clark Fork	Upper Clark Fork
Wet meadow (%)	0	0	0	0	3
Willow flats(%)	55	0	6	6	16
Cottonwood Bottomland(%)	42	100	71	80	55
Streamside Riparian(%)	0	0	24	6	21

Table 2. Percentage of points with evidence of grazing in 2005 by watershed.

Watershed	Points grazed (%)
Big Hole	64
Bitterroot	0
Lower Flathead	12
Middle Clark Fork	6
Upper Clark Fork	21

Local vegetation characteristics at point count stations also varied greatly across watersheds (Table 3). For example, willow shrub cover ranged from less than 1.6% in the Bitterroot to over 13% in the Big Hole, while cottonwood (*Populus spp.*) densites ranged from 61 trees/ha on the Upper Clark Fork to over 171 trees/ha on the Bitterroot.

Table 3. Summary by watershed of several local vegetation measures sampled at point count stations.

Vegetation Measures	Big Hole		Bitterroot		Lower Flathead		Middle Clark Fork		Upper Clark Fork	
	x	sd	x	sd	x	sd	x	sd	x	sd
Grass (%)	36.0	12.5	30.0	10.2	31.7	15.7	27.3	13.5	24.9	11.28
Forb (%)	20.0	8.8	14.8	13.4	17.1	9.2	12.5	8.5	24.3	10.43
Bare Ground (%)	31.7	19.8	34.3	20.5	37.2	17.1	38.2	13.9	41.1	13.8
Willow spp. cover (%)	13.4	11.4	1.6	3.1	3.6	5.3	2.9	6.5	4.4	8.53
Total Shrub Cover (%)	18.1	12.6	9.4	11.4	28.1	16.4	12.2	16.3	20.5	17.72
Canopy Cover (%)	10.5	16.3	29.5	11.7	23.8	15.0	23.8	16.8	18.6	13.23
Shrub Height (m)	1.6	0.8	0.0	0.7	1.1	0.9	0.8	0.9	0.9	0.61
Canopy Height (m)	10.5	14.2	25.2	7.4	16.1	8.9	20.3	9.8	14.4	9.58
Cottonwoods (per ha)	73.0	110.9	171.7	127.8	84.9	85.0	156.9	154.4	61.5	3.16
Conifers (per ha)	1.2	6.7	38.2	54.9	16.9	18.8	28.1	71.7	4.1	0.33
Snags (per ha)	6.6	12.6	18.7	20.0	18.3	24.7	24.3	25.4	19.3	0.9

Analysis Approach

We are presently investigating factors that influence distributions of birds in riparian habitats at local and regional scales. Understanding how these factors influence avian populations will help in implementing habitat restoration and developing conservation strategies for these critical habitats. A variety of metrics related to local vegetation structure and composition can be derived from the vegetation samples conducted at point count stations for analyzing habitat relationships. In addition to vegetation measures taken in the field, we we are delineating selected patches using digital orthophotos in GIS to obtain measures of patch size and shape (ESRI 2004). Landscape scale composition and configuration will be derived from the Montana Satellite Imagery Land Cover Classification (MTSILC3; Wildlife Spatial Analysis Lab, website: http://www.wru.umt.edu/), and National Wetlands Inventory (NWI) layers where available using FRAGSTATS and GIS software (McGarigal et al. 2002, ESRI 2004).

We are developing models to predict species density, occurrence, and species richness as a function of local, patch, and landscape measures. For species with >100 detections, we are modeling bird density using linear regression (see below for method used to estimate density). For species with >10 detections but <100, we are modeling species occurrence using logistic regression. For species richness (number of species detected/point), we are using Poisson regression. In species occurrence and species richness models, each point count location is considered a sampling unit, but points within patches are analyzed as correlated repeated measures (Johnson and Igl 2001). Bird density is estimated for species per patch, so the patch is considered the sampling unit. After a single year of surveys, we do have sufficient data to model density for only the 5 most abundant species. Bird density models for more species will be possible in future years as additional watersheds are sampled and by pooling data across collaborating studies (e.g. Madison-Missouri PPL-MT dataset).

Our modeling approach includes the following steps:

1) Compare models that include local vegetation measurements only, landscape measurements only (derived from GIS layers), and models including both information. Models are compared based on an information-theoretic approach using Akaike's Information Criterion adjusted for small sample sizes (AICc; Burham and Anderson 1998).

2) For the best model type found in step 1, we will compare reduced models (including tests for non-linearity in responses) to estimate the most parsimonious model describing bird abundance/occurrence/richness.

3) For models developed in step 2 that contain GIS measures, we will develop predictive maps for species distribution/abundance/richness for the region.

This approach permits explicit evaluation of the factors influencing bird distributions at the appropriate scale, selects the most broadly applicable model, and provides important deliverables to land managers so that they may identify important areas for conservation, and understand potential implications of different restoration and land management scenarios. Preliminary findings with the Madison-Missouri PPL-MT dataset, demonstrate the potential of this modeling approach (Fletcher et al. 2005). For example, the landscape-only model was sufficient for predicting Least Flycatcher abundance along a section of the Missouri (based on AICc), and the most parsimonious model was the amount of riparian habitat in the landscape. From this model, the predicted abundance of flycatchers in riparian habitats was mapped by linking the abundance model to NWI and SILC maps of the river (Fig. 4). Once we have developed habitat models from the 2005 bird surveys and vegetation data, we can create predictive maps for the watersheds in western Montana.

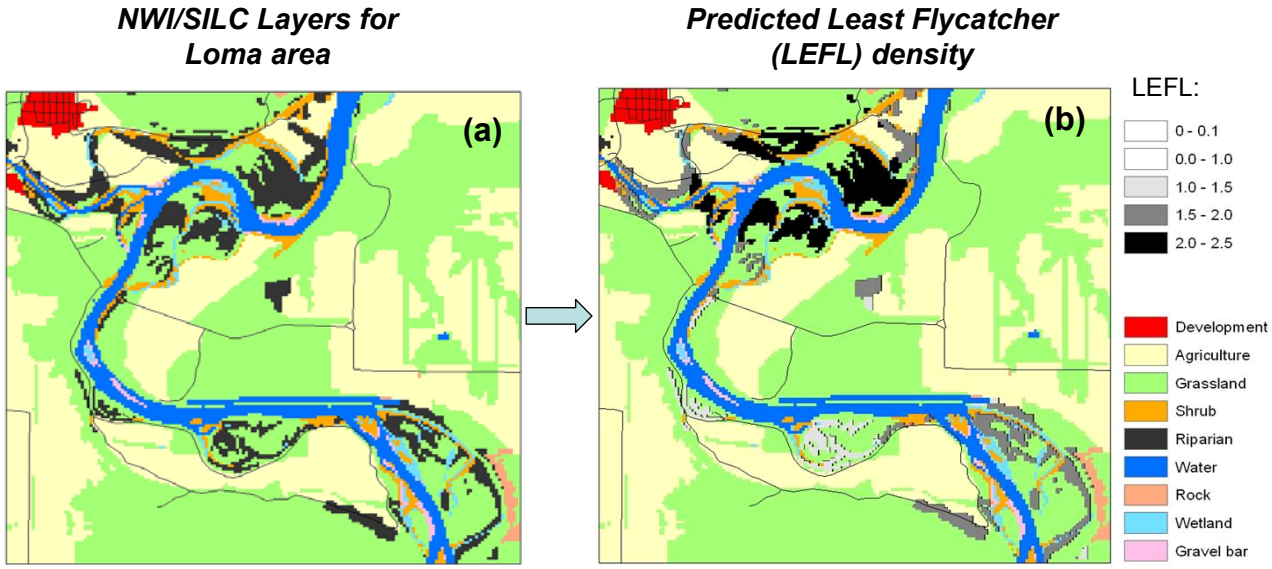

Figure 4. An example of combining (a) GIS layers with the habitat model developed from monitoring to generate a (b) predictive bird abundance map of the least flycatcher based on monitoring data from a section of the Missouri River, 2004-2005 (from Fletcher et al. 2005).

Conclusions and Recommendations

The final riparian monitoring plan outlined in this report is designed to provide important baseline data on bird distributions and long-term population trends for a large number of Montana's breeding birds, including species of concern. By systematically sampling vegetation at monitoring sites and using available GIS analysis techniques, we can also develop habitat models for riparian species and evaluate the influence of management and land use practices on riparian bird species. In 2005 we established long-term monitoring sites and collected baseline bird distribution data for western Montana. Recommendations for future riparian bird monitoring include:

1. *Select additional watersheds for monitoring.* Select watersheds and set up monitoring sites in eastern Montana in 2006. As bird and vegetation data is compiled from additional watersheds and cooperating projects, more opportunities for understanding the factors influencing bird

distributions in riparian habitats will be possible, and region-specific habitat models can be developed. It is important to recognize that patterns observed in one geographic region may not be applicable to other areas, and, therefore, it is critical to monitor all regions of interest in order to provide reliable information for area managers.

2. *Continue long-term monitoring of sites.* In 2007, revisit sites surveyed in western Montana in 2005 and select a reduced subset for long-term monitoring from the Madison-Missouri PPL-MT sites. Long-term monitoring will provide an invaluable tool for managers to identify species declines with ongoing landscape change.

3. *Validate habitat models.* GIS-based predictive models should be validated to determine model accuracy. This is critical for understanding the reliability for informing management strategies. Model validation requires a single season of surveying a select number of new sites in each watershed to evaluate how well the models predict actual bird numbers.

4. *Expand monitoring plan to include riparian habitats along small-order streams.* Large-order streams were targeted for initial monitoring efforts because they support relatively higher bird diversity and are highly impacted by anthropogenic disturbance. However, small order streams also serve as critical habitat for many riparian bird species in the state.

5. *Expand state-wide partnerships*. Continue to advocate amongst public and private partners within the State for sign-on to the Montana Coordinated Bird Monitoring Plan; this will allow us to increase our abilities to adequately monitor populations in the long-term, especially the less common species or species at risk.

Literature Cited

Beever, E. A., R. J. Tausch, and P. F. Brussard. 2003. Characterizing grazing disturbance in semiarid ecosystems across broad scales, using diverse indices. Ecological Applications 13:119-136.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 2001. Distance sampling: estimating abundance of biological populations. Chapman & Hall, London.

Burnham, K. P., and D. R. Anderson. 1998. Model selection and inference: a practical information-theoretic approach. Springer-Verlag, New York.

ESRI. 2004. ArcGIS: Release 9.0 [Software]. Environmental Systems Research Institute. Redlands, CA

Farnsworth, G. L., K. H. Pollock, J. D. Nichols, T. R. Simons, J. E. Hines, and J. R. Sauer. 2002. A removal model for estimating detection probabilities from point-count surveys. Auk 119:414-425.

Fletcher, R., T. Smucker, and R.L. Hutto. 2005. Distribution Of Birds In Relation To Vegetation Structure And Land Use Along The Missouri And Madison River Corridors: Final Report. Avian Science Center, Missoula, MT. http://avianscience.dbs.umt.edu/research_riparian_madison.htm

Hutto, R. L., S. M. Pletschet, and P. Hendricks. 1986. A fixed-radius point count method for nonbreeding and breeding season use. Auk 103: 593-602.

Hutto, R. L., and J. S. Young. 2002. Regional landbird monitoring: perspectives from the northern Rocky Mountains. Wildlife Society Bulletin 30:738-750.

Johnson, D. H., and L. D. Igl. 2001. Area requirements of grassland birds: a regional perspective. Auk 118:24-34.

McGarigal, K., S. A. Cushman, M. C. Neel, and E. Ene. 2002. FRAGSTATS: Spatial Pattern Analysis Program for Categorical Maps. Version 3.3, Software. University of Massachusetts, Amherst. Available at the following web site: www.umass.edu/landeco/research/fragstats/fragstats.html

Appendix A. Location and ownership for point count stations surveyed in western Montana in 2005.

Station	Watershed	Latitude	Longitude	Ownership
BHOLE01-2	Big Hole	45.50065	-112.69165	BLM
BHOLE01-3	Big Hole	45.49929	-112.69234	BLM
BHOLE01-4	Big Hole	45.49817	-112.69306	BLM
BHOLE04-1	Big Hole	45.42024	-113.44584	Private
BHOLE04-2	Big Hole	45.41889	-113.44577	Private
BHOLE05-1	Big Hole	45.50860	-113.49109	Private
BHOLE05-2	Big Hole	45.50732	-113.49206	Private
BHOLE08-1	Big Hole	45.30674	-113.45096	Private
BHOLE08-2	Big Hole	45.30852	-113.45207	Private
BHOLE08-3	Big Hole	45.30978	-113.45142	Private
BHOLE08-4	Big Hole	45.31103	-113.45070	Private
BHOLE08-8	Big Hole	45.31152	-113.45247	Private
BHOLE08-9	Big Hole	45.31024	-113.45319	Private
BHOLE09-1	Big Hole	45.66828	-112.69868	MTFWP
BHOLE09-2	Big Hole	45.66967	-112.69895	MTFWP
BHOLE09-3	Big Hole	45.67090	-112.69929	MTFWP
BHOLE11-1	Big Hole	45.50009	-113.48859	Private
BHOLE11-2	Big Hole	45.50163	-113.48934	Private
BHOLE12-1	Big Hole	45.30674	-113.45096	Private
BHOLE12-2	Big Hole	45.30852	-113.45207	Private
BHOLE20-1	Big Hole	45.43873	-112.62485	Private
BHOLE20-2	Big Hole	45.43797	-112.62346	Private
BHOLE20-3	Big Hole	45.43709	-112.62193	Private
BHOLE20-4	Big Hole	45.43616	-112.62046	Private
BHOLE20-5	Big Hole	45.43531	-112.61903	Private
BHOLE22-1	Big Hole	45.51991	-113.48647	Private
BHOLE22-2	Big Hole	45.51963	-113.48475	Private
BHOLE22-3	Big Hole	45.52117	-113.48613	Private
BHOLE22-4	Big Hole	45.52094	-113.48436	Private
BHOLE26-2	Big Hole	45.42900	-113.45276	Private
BHOLE26-3	Big Hole	45.43013	-113.45377	Private
BHOLE26-4	Big Hole	45.43129	-113.45462	Private
BHOLE26-5	Big Hole	45.42677	-113.45053	Private
BITTE02-1	Bitterroot	46.57632	-114.08154	USFWS
BITTE02-2	Bitterroot	46.57708	-114.08017	USFWS
BITTE02-3	Bitterroot	46.57588	-114.07975	USFWS
BITTE04-1	Bitterroot	46.47346	-114.10953	Private
BITTE04-2	Bitterroot	46.47371	-114.11358	Private
BITTE04-3	Bitterroot	46.47550	-114.10945	Private
BITTE07-1	Bitterroot	46.57588	-114.07975	Private
BITTE07-15	Bitterroot	46.10498	-114.18282	Private
BITTE07-15	Bitterroot	46.10498	-114.18282	Private
BITTE07-17	Bitterroot	46.10435	-114.17926	Private
BITTE07-17	Bitterroot	46.10435	-114.17926	Private
BITTE07-18	Bitterroot	46.10568	-114.17890	Private
BITTE07-18	Bitterroot	46.10568	-114.17890	Private
BITTE07-19	Bitterroot	46.10589	-114.18073	Private
BITTE07-19	Bitterroot	46.10589	-114.18073	Private
BITTE11-1	Bitterroot	46.04479	-114.16816	Private
BITTE11-2	Bitterroot	46.04688	-114.16940	Private
BITTE11-3	Bitterroot	46.04826	-114.16991	Private
BITTE11-4	Bitterroot	46.04981	-114.17043	Private

BITTE11-5	Bitterroot	46.05139	-114.17080	Private
BITTE12-1	Bitterroot	46.00264	-114.16561	Private
BITTE12-2	Bitterroot	46.00149	-114.16626	Private
BITTE13-1	Bitterroot	46.32141	-114.14997	Private
BITTE13-2	Bitterroot	46.32269	-114.14887	Private
BITTE13-3	Bitterroot	46.32408	-114.14902	Private
BITTE15-1	Bitterroot	45.99376	-114.16726	Private
BITTE15-2	Bitterroot	45.99280	-114.16569	Private
BITTE17-2	Bitterroot	46.77899	-114.07718	MTFWP
BITTE17-3	Bitterroot	46.77999	-114.07840	MTFWP
BITTE17-4	Bitterroot	46.78107	-114.07980	MTFWP
BITTE17-5	Bitterroot	46.78210	-114.08096	MTFWP
BITTE17-7	Bitterroot	46.78424	-114.08342	MTFWP
BITTE18-10	Bitterroot	46.77041	-114.06140	Private
BITTE18-15	Bitterroot	46.77394	-114.06755	Private
BITTE18-16	Bitterroot	46.77488	-114.06945	Private
BITTE18-2	Bitterroot	46.76638	-114.06383	Private
BITTE18-4	Bitterroot	46.76768	-114.06338	Private
BITTE18-5	Bitterroot	46.76762	-114.06541	Private
BITTE18-7	Bitterroot	46.76910	-114.06345	Private
BITTE18-8	Bitterroot	46.76905	-114.06540	Private
BITTE18-9	Bitterroot	46.77035	-114.06347	Private
BITTE21-1	Bitterroot	46.56668	-114.09944	Private
BITTE21-2	Bitterroot	46.56738	-114.09779	Private
BITTE21-3	Bitterroot	46.56828	-114.09629	Private
BITTE21-4	Bitterroot	46.56960	-114.09569	Private
BITTE22-1	Bitterroot	46.58478	-114.06435	USFWS
BITTE22-10	Bitterroot	46.58958	-114.05499	USFWS
BITTE22-2	Bitterroot	46.58382	-114.06293	USFWS
BITTE22-3	Bitterroot	46.58568	-114.06309	USFWS
BITTE22-4	Bitterroot	46.58687	-114.06220	USFWS
BITTE22-6	Bitterroot	46.58679	-114.05932	USFWS
BITTE22-8	Bitterroot	46.58813	-114.05844	USFWS
BITTE22-9	Bitterroot	46.58869	-114.05636	USFWS
LFLAT01-01	Lower Flathead	47.34206	-114.69325	Flathead Res.
LFLAT04-01	Lower Flathead	47.32498	-114.41982	Flathead Res.
LFLAT04-05	Lower Flathead	47.32614	-114.41750	Flathead Res.
LFLAT04-06	Lower Flathead	47.32793	-114.42010	Flathead Res.
LFLAT04-08	Lower Flathead	47.32634	-114.42214	Flathead Res.
LFLAT07-01	Lower Flathead	47.35060	-114.53569	Private
LFLAT07-02	Lower Flathead	47.35135	-114.53639	Private
LFLAT11-01	Lower Flathead	47.32300	-114.44951	Flathead Res.
LFLAT16-01	Lower Flathead	47.35344	-114.28441	Flathead Res.
LFLAT17-01	Lower Flathead	47.32957	-114.33849	Flathead Res.
LFLAT18-01	Lower Flathead	47.32721	-114.38823	Flathead Res.
LFLAT18-02	Lower Flathead	47.32787	-114.39205	Flathead Res.
LFLAT18-03	Lower Flathead	47.32687	-114.39066	Flathead Res.
LFLAT22-01	Lower Flathead	47.33533	-114.30382	Flathead Res.
LFLAT22-02	Lower Flathead	47.33564	-114.30605	Flathead Res.
LFLAT23-03	Lower Flathead	47.34052	-114.51130	Flathead Res.
LFLAT30-01	Lower Flathead	47.33770	-114.64323	Private
MCLAR06-1	Middle Clark Fork	46.87585	-114.01108	Private
MCLAR10-1	Middle Clark Fork	47.01608	-114.40388	State
MCLAR10-2	Middle Clark Fork	47.01513	-114.40521	State
MCLAR10-3	Middle Clark Fork	47.01407	-114.40636	State
MCLAR10-4	Middle Clark Fork	47.01280	-114.40731	State
MCLAR13-1	Middle Clark Fork	47.00946	-114.28063	State

MCLAR13-2	Middle Clark Fork	47.00986	-114.28279	State
MCLAR13-3	Middle Clark Fork	47.01085	-114.27920	State
MCLAR13-4	Middle Clark Fork	47.01168	-114.28118	State
MCLAR15-1	Middle Clark Fork	47.02148	-114.35566	Private
MCLAR15-2	Middle Clark Fork	47.02016	-114.35625	Private
MCLAR16-1	Middle Clark Fork	47.01537	-114.53922	State
MCLAR16-2	Middle Clark Fork	47.01429	-114.54044	State
MCLAR16-3	Middle Clark Fork	47.01304	-114.54054	State
MCLAR22-1	Middle Clark Fork	46.96499	-114.22534	Private
MCLAR22-2	Middle Clark Fork	46.96385	-114.22421	Private
MCLAR22-3	Middle Clark Fork	46.96254	-114.22317	Private
MCLAR23-1	Middle Clark Fork	46.86154	-113.96436	City of Missoula
MCLAR23-2	Middle Clark Fork	46.86147	-113.96632	City of Missoula
MCLAR23-3	Middle Clark Fork	46.86140	-113.96820	City of Missoula
MCLAR25-1	Middle Clark Fork	46.90955	-114.16095	MTFWP
MCLAR25-2	Middle Clark Fork	46.91367	-114.16467	MTFWP
MCLAR25-3	Middle Clark Fork	46.90965	-114.17117	MTFWP
MCLAR25-4	Middle Clark Fork	46.90960	-114.16495	MTFWP
MCLAR25-5	Middle Clark Fork	46.91165	-114.16000	MTFWP
MCLAR26-1	Middle Clark Fork	46.87162	-114.05973	City of Missoula
MCLAR26-2	Middle Clark Fork	46.87237	-114.06148	City of Missoula
MCLAR26-3	Middle Clark Fork	46.87366	-114.06282	City of Missoula
MCLAR26-4	Middle Clark Fork	46.87395	-114.06475	City of Missoula
MCLAR26-5	Middle Clark Fork	46.87312	-114.06633	City of Missoula
MCLAR28-1	Middle Clark Fork	46.87366	-114.06282	State
MCLAR28-2	Middle Clark Fork	46.92345	-114.19460	State
UCLAR00-1	Upper Clark Fork	46.56065	-112.88676	Private
UCLAR00-3	Upper Clark Fork	46.55814	-112.88382	Private
UCLAR00-4	Upper Clark Fork	46.55743	-112.88274	Private
UCLAR00-5	Upper Clark Fork	46.55675	-112.88092	Private
UCLAR01-1	Upper Clark Fork	46.81716	-113.79931	Private
UCLAR02-1	Upper Clark Fork	46.71219	-113.33245	Private
UCLAR03-1	Upper Clark Fork	46.70378	-113.36339	MT DNRC
UCLAR04-10	Upper Clark Fork	46.78618	-113.74595	Private
UCLAR04-2	Upper Clark Fork	46.78462	-113.74021	Private
UCLAR04-3	Upper Clark Fork	46.78574	-113.73924	Private
UCLAR04-5	Upper Clark Fork	46.78512	-113.74438	Private
UCLAR04-6	Upper Clark Fork	46.78672	-113.74149	Private
UCLAR04-7	Upper Clark Fork	46.78709	-113.74740	Private
UCLAR04-8	Upper Clark Fork	46.78675	-113.74339	Private
UCLAR04-9	Upper Clark Fork	46.78715	-113.74531	Private
UCLAR06-2	Upper Clark Fork	46.70271	-113.50172	MT DNRC
UCLAR07-1	Upper Clark Fork	46.69527	-113.21211	BLM
UCLAR07-2	Upper Clark Fork	46.69540	-113.21021	BLM
UCLAR07-3	Upper Clark Fork	46.69486	-113.20860	BLM
UCLAR07-4	Upper Clark Fork	46.69418	-113.20691	BLM
UCLAR09-1	Upper Clark Fork	46.71058	-113.51677	Private
UCLAR10-1	Upper Clark Fork	46.54718	-112.85493	Private
UCLAR10-2	Upper Clark Fork	46.54594	-112.85394	Private
UCLAR10-3	Upper Clark Fork	46.54481	-112.85289	Private
UCLAR11-1	Upper Clark Fork	46.48654	-112.72965	Private
UCLAR11-2	Upper Clark Fork	46.48594	-112.72790	Private
UCLAR13-1	Upper Clark Fork	46.47433	-112.72729	Private
UCLAR13-2	Upper Clark Fork	46.47275	-112.72679	Private
UCLAR16-2	Upper Clark Fork	46.35306	-112.73812	Private
UCLAR16-7	Upper Clark Fork	46.35213	-112.73672	Private
UCLAR18-1	Upper Clark Fork	46.46943	-112.72651	Private

UCLAR24-1	Upper Clark Fork	46.38374	-112.73592	County
UCLAR24-2	Upper Clark Fork	46.38245	-112.73603	County
UCLAR26-1	Upper Clark Fork	46.76811	-113.72068	Unk. Federal
UCLAR26-2	Upper Clark Fork	46.76568	-113.72067	Unk. Federal
UCLAR26-3	Upper Clark Fork	46.76694	-113.72049	Unk. Federal

Appendix B. Bird species abundance across 5 watersheds surveyed in western Montana in 2005 (values are means number of detections in two visits). Partners in Flight priority status (PIF) I = conservation action, II = monitoring, III = local concern.

SpeciesCode	PIF Priority Status	Big Hole	Bitterroot	Lower Flathead	Middle Clark Fork	Upper Clark Fork	Total
American Bittern	III	1.0	0.0	0.0	0.0	0.0	1.0
American Crow		6.5	7.0	1.5	2.5	7.5	25.0
American Goldfinch		4.0	2.5	5.0	7.0	7.5	26.0
American Kestrel		0.0	0.0	1.0	1.0	1.0	3.0
American Redstart	III	0.0	5.0	0.0	5.0	11.0	21.0
American Robin		47.0	45.0	21.0	25.5	19.5	158.0
Bald Eagle	II	1.0	0.0	0.0	0.0	1.0	2.0
Barrow's Goldeneye	II	0.0	0.0	0.0	1.0	0.0	1.0
Belted Kingfisher		2.0	2.0	3.0	2.0	1.0	10.0
Black-billed Magpie		19.5	16.5	9.5	4.0	8.5	58.0
Black-capped Chickadee		11.0	27.5	14.0	14.0	13.5	80.0
Black-chinned Hummingbird		1.0	1.0	0.0	1.5	0.0	3.5
Black-headed Grosbeak		1.5	4.5	4.0	6.5	6.5	23.0
Blue-winged Teal		1.0	0.0	0.0	0.0	0.0	1.0
Bobolink	III	0.0	0.0	1.0	0.0	0.0	1.0
Brewer's Blackbird	III	16.0	2.0	0.0	4.0	2.5	24.5
Brown-headed Cowbird		77.0	44.0	12.0	12.5	42.0	187.5
Bullock's Oriole		9.5	26.0	11.5	12.0	15.5	74.5
Calliope Hummingbird	II	0.0	2.0	2.0	1.5	2.5	8.0
Canada Goose		1.0	0.0	0.0	3.0	0.0	4.0
Cassin's Finch	III	0.0	0.0	0.0	1.0	0.0	1.0
Cedar Waxwing		0.0	9.5	5.5	9.5	12.0	36.5
Chipping Sparrow	III	0.0	1.5	0.0	5.5	1.0	8.0
Clark's Nutcracker	III	0.0	0.0	2.0	0.0	0.0	2.0
Cliff Swallow		1.0	0.0	0.0	20.0	14.0	35.0
Common Nighthawk		1.0	0.0	4.0	0.0	0.0	5.0
Common Raven		0.0	1.0	0.0	2.5	0.0	3.5
Common Yellowthroat		0.0	1.0	0.0	0.0	1.0	2.0
Cordilleran Flycatcher	II	0.0	3.0	0.0	0.0	0.0	3.0
Double-crested Cormorant		0.0	0.0	0.0	2.0	0.0	2.0
Downy Woodpecker	III	1.0	2.5	1.0	6.5	2.0	13.0
Dusky Flycatcher		0.0	2.0	0.0	2.0	2.0	6.0
Eastern Kingbird		3.5	3.5	8.0	3.5	4.0	22.5
European Starling		16.0	9.5	5.0	4.5	9.5	44.5
Grasshopper Sparrow	II	3.0	0.0	0.0	0.0	0.0	3.0
Gray Catbird	III	12.0	4.5	11.0	16.5	19.0	63.0
Great Blue Heron		2.0	3.5	0.0	2.5	1.0	9.0
Great Horned Owl		1.0	2.5	0.0	0.0	0.0	3.5
Hairy Woodpecker		6.0	9.0	3.0	2.0	6.5	26.5
Hammond's Flycatcher	II	0.0	0.0	0.0	1.0	2.0	3.0
Harlequin Duck	I	0.0	0.0	0.0	0.0	2.0	2.0
House Finch		0.0	7.0	0.0	0.0	0.0	7.0
House Sparrow		0.0	0.0	0.0	9.0	0.0	9.0
House Wren		15.5	20.0	10.5	17.0	4.0	67.0
Killdeer	III	2.0	1.0	1.0	1.0	2.0	7.0
Lark Sparrow	III	0.0	0.0	0.0	0.0	1.0	1.0
Lazuli Bunting	II	0.0	2.0	1.0	0.0	1.5	4.5
Least Flycatcher	III	2.5	3.5	0.0	2.0	1.0	9.0

Lewis' Woodpecker	II	0.0	3.0	2.0	1.0	0.0	6.0
Lincoln's Sparrow		6.0	0.0	0.0	0.0	1.0	7.0
Long-billed Curlew	II	1.0	0.0	0.0	0.0	0.0	1.0
MacGillivray's Warbler	III	0.0	1.0	0.0	2.0	0.0	3.0
Mallard Duck		1.0	2.5	2.0	6.5	3.0	15.0
Marsh Wren		0.0	0.0	0.0	0.0	1.0	1.0
Mountain Bluebird		0.0	0.0	0.0	0.0	2.0	2.0
Mountain Chickadee		0.0	0.0	0.0	0.0	2.0	2.0
Mourning Dove		7.5	8.0	8.5	3.0	2.0	29.0
Northern Flicker		11.0	12.5	4.0	12.0	4.0	43.5
Northern Rough-winged Swallow		0.0	0.0	0.0	2.0	0.0	2.0
Northern Waterthrush		11.5	3.5	0.0	0.0	1.0	16.0
Osprey		2.0	3.0	1.0	4.0	1.0	11.0
Pygmy Nuthutch		0.0	10.0	0.0	3.0	0.0	13.0
Red-breasted Nuthatch		1.0	3.0	0.0	1.0	5.0	10.0
Red-naped Sapsucker	II	0.0	13.0	0.0	7.0	3.0	23.0
Red-tailed Hawk		1.0	2.5	2.0	1.0	1.0	7.5
Red-winged Blackbird	III	10.0	10.5	3.5	1.0	12.5	37.5
Ruby-crowned Kinglet		0.0	1.0	0.0	0.0	0.0	1.0
Ruffed Grouse	II	0.0	6.0	0.0	0.0	0.0	6.0
Rufous Hummingbird	III	1.0	2.0	0.0	0.0	0.0	3.0
Sandhill Crane		5.0	0.0	0.0	0.0	0.0	5.0
Savannah Sparrow		3.5	0.0	0.0	0.0	2.0	5.5
Sharp-shinned Hawk	III	0.0	1.0	0.0	0.0	0.0	1.0
Solitary Vireo		0.0	8.0	0.0	4.5	1.0	13.5
Song Sparrow	III	27.0	21.5	8.0	23.5	37.5	117.5
Sora		1.0	0.0	0.0	0.0	0.0	1.0
Spotted Sandpiper		9.0	18.5	4.0	13.0	11.5	56.0
Spotted Towhee		0.0	1.0	0.0	2.0	2.5	5.5
Steller's Jay		0.0	0.0	0.0	0.0	1.0	1.0
Tree Swallow		9.5	13.5	7.5	16.0	6.0	52.5
Turkey Vulture		0.0	0.0	0.0	9.0	0.0	9.0
Vaux's Swift	II	0.0	6.0	0.0	0.0	0.0	6.0
Veery	III	2.0	1.0	0.0	1.0	4.5	8.5
Vesper Sparrow		1.0	0.0	0.0	1.0	0.0	2.0
Violet-green Swallow		0.0	7.0	1.0	2.0	1.0	11.0
Warbling Vireo	III	4.5	16.5	4.0	9.5	15.5	50.0
Western Meadowlark		4.0	0.0	1.0	1.0	5.0	11.0
Western Tanager		1.0	1.0	0.0	1.0	7.0	10.0
Western Wood-pewee		26.5	50.5	19.5	29.0	10.0	135.5
White-breasted Nuthatch		2.0	5.0	0.0	2.5	1.0	10.5
White-crowned Sparrow		8.5	0.0	0.0	0.0	0.0	8.5
White-throated Swift		0.0	0.0	0.0	2.0	0.0	2.0
Willow Flycatcher	II	9.5	3.0	3.5	15.5	24.5	56.0
Wilson's Phalarope	III	3.5	0.0	0.0	0.0	0.0	3.5
Wilson's Snipe		21.5	0.0	1.0	0.0	0.0	22.5
Wilson's Warbler		0.0	4.0	1.0	0.0	0.0	5.0
Wood Duck		0.0	2.0	0.0	1.0	0.0	3.0
Yellow Warbler		81.0	115.5	28.5	78.0	77.0	380.0
Yellow-headed Blackbird	III	5.5	1.0	0.0	0.0	0.0	6.5
Yellow-rumped Warbler		2.0	1.0	0.0	2.0	2.0	7.0
Total		364.0	403.0	172.5	297.5	319.0	1556.0